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The normativity of ecological restoration reference models: An analysis of Carrifran Wildwood, Scotland, and Walden Woods, United States

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Introduction

To achieve the material restoration of a historical landscape state, restorationists need to first identify the principal socio-ecological properties of past environments to act as a guide. This guide is termed the reference model, reference ecosystem, reference site, or simply the reference (Clewell and Aronson, 2007, p. 75; Egan and Howell, 2001; Choi, 2004). These guides are assembled through the collation of information from a potential range of sources, including both cultural artifacts (written documents, land surveys, oral histories, maps, photographs) and ecological data sets derived from a variety of approaches (such as dendrochronology, palynology, and observed field evidence) (see Egan and Howell, 2001); when various sources are used, the reference model is described as a 'composite description' (SER, 2004, p. 8). Such socio-ecological information is not necessarily derived from the landscape to be restored; extant landscapes that are analogous to a desired historical state or range can also be used as a source of information to create a reference model (White and Walker, 1997).

Due to non-equilibrial dynamics, there are potentially multiple pathways of successional development within any given ecosystem, giving rise to ecosystemic uncertainty and thus an inability to predict the nature of future ecosystem development (see Hobbs and Cramer, 2008;

Palmer *et al*., 1997; Pickett and Parker, 1994; Scoones, 1999). Indeed, it appears that periods of non-equilibrial change are more prevalent in evolutionary history than are periods of equilibrial stasis (Rohde, 2005, p. 182-188). Field research has demonstrated that, at least in some instances, restored ecosystems do not develop in a predictable, linear manner (Duarte *et al*., 2009; Cortina *et al*., 2006; Suding and Gross, 2006; Zedler and Callaway, 1999). Because of the stochastic qualities of ecological systems through time, the idea that ecological restoration should seek to wholly replicate a (static) historically aligned reference has been dismissed as unrealistic (see Clewell and Aronson, 2007, p. 75-87), yet this idea is still being perpetuated to the point where it has been characterized as one of the 'pitfalls' (Pickett and Parker, 1994) or 'myths' (Hilderbrand *et al*., 2005) of restoration.

These criticisms have led to the formulation of the 'dynamic reference' concept, in which multiple potential ecosystem trajectories with varying species compositions inform the production of reference models, and strict historical fidelity to a static 'pre-disturbance' point in time is rejected (Hiers *et al*., 2012; see also Hall, 2010; Suding *et al*., 2004). Further, literature has started to emerge that tentatively rethinks the temporal orientation of ecological restoration. Hobbs and Harris (2001) believe that restorationists should be 'setting goals for restoration which focus on the desired characteristics for the system *in the future*' (Hobbs and Harris, 2001, p. 241; emphasis in original, cf. Wiens *et al*., 2012), meaning that there needs to be a shift from a 'historic' to a 'futuristic' restoration paradigm (Choi, 2004; see also Halle, 2007; Harris *et al*., 2006). For others, this seems especially pressing given 'the increasing likelihood of a no-analogue future, one in which we have no historical reference point to refer to' (Hobbs and Cramer, 2008, p. 50-51). Such restorations may give rise to hybrid ecosystems, which meld historical and nonhistorical species and ecological processes, or entirely "novel" ecosystems (see Jackson and Hobbs, 2009; Higgs, 2012). The importance of the role of historical fidelity within reference models assumes a renewed urgency in light of rapid environmental change and

accelerating climate destabilisation (Higgs *et al*., 2014; Safford *et al*., 2012; Wiens and Hobbs, 2015).

As a means to classify the influence of historic fidelity on setting ecological restoration objectives, Aronson *et al.* (1993) differentiate between strict historical fidelity goals, which they term *sensu stricto* ('narrow sense') restoration, and restoration goals geared toward generally moving 'a disturbed ecosystem in a trajectory that [is] presumed to have prevailed prior to the onset of disturbance' (Aronson *et al.*, 1993, p. 9), which they term *sensu lato* ('broad sense') restoration. Regardless of whether the goal of a restoration is *sensu stricto* or *sensu lato*, creating a reference model remains a necessary step for both the design and evaluation of a project (Aronson *et al.*, 1993, p. 10; Aronson *et al*., 1995; Harris and Van Diggelen, 2006, p.12; Hobbs and Norton, 1996, p.101; Ruiz-Jaen and Aide, 2005; Zedler and Adam, 2002, p. 260), even if the 'reference model serves more as a starting point for planning than as a fixed target' (Clewell, 2009, p. 244). Indeed, if a reference model is not used as a target for restoration practice, a project '...lacks direction and probably should not even qualify as ecological restoration' (Clewell and Aronson, 2007, p. 75). When a composite – as opposed to a single reference ecosystem – is used, 'a project is satisfactory as long as the restored ecosystem falls within the array of biodiversity encompassed by the composite model' (Clewell, 2009, p. 245).

We can thus detect various threads of discussion within the ecological restoration literature about reference models, including what information they should be based upon, what temporal dimensions are appropriate for their construction, and how flexible restorationists should be in using them as definitive targets for restoration activities. However, there is a surprising lack of discussion about what exactly ecological restoration reference models *are*, even in academic texts solely dedicated to introducing the concept (see Egan and Howell, 2001). From the existing literature, it may appear that the answer is clear: biological and cultural data is used to produce scientific-technical guides that direct restoration activities. It is our proposition in this article,

however, that such a way of framing reference models overlooks much of what it is that they represent, how they come to be, and to what work they are put.

Through an analysis of two ecological restoration projects, one in Dumfries and Galloway, Scotland, and one in Massachusetts, the United States, we shall argue that these two reference models are highly normative representations – or, as we shall term them, normative visions – of desired future ecosystem states. We shall show how these visions are an amalgamation of intersubjective social and ecological values held by those working within each project, and how in turn these reference models act as guides to reproducing these values within a given landscape. We end by discussing how the normativity of these two ecological restoration models challenges a widespread assumption within the ecological restoration literature that the historical landscape states that inform such models are necessarily arbitrarily chosen moments in time. We do so not from a perspective of using the two case studies to illustrate *generalizable* a priori arguments about reference models; rather, we wish to interrogate the *specific* claims and value judgments that are made by the respective groups of restorers themselves. We therefore wish to caution against assuming that what we report here is applicable to all and every ecological restoration reference model. Instead, we wish to open up some space in which to reflect upon the prevailing status of reference models as scientific-technical guides. Before turning to develop these ideas, we shall now outline the two restoration projects under discussion, their principal objectives, the values that they represent, and how their respective reference models were produced.

The Making of Two Ecological Restoration Reference Models

i. The Carrifran Wildwood Restoration Project

Within the Moffat Hills in Dumfries and Galloway, a constituent of the Southern Uplands of Scotland, lies a 640-hectare valley approximately 7.5 miles north of the town of Moffat. In November of 1997 Borders Forest Trust, an environmental charity with a particular focus on

woodland restoration in southern Scotland, purchased the valley and named it 'Carrifran Wildwood'. In 2000 a *sensu stricto* restoration began through the work of a semi-autonomous voluntary grouping within the Trust called the Wildwood Group (herein referred to as 'the Group'). By 2009, over half a million trees and shrubs had been directly planted within the valley.

From the very beginning of the project, a discrete set of values have been intrinsically intertwined with the restoration; these values served as the motivational force behind initiating the restoration project, and have become codified in the project's stated objectives. This region of Scotland has a long history of certain land uses, with sheep farming predominating here since at least the 13th century (Goodburn, 2009, p. 58). This has maintained a particular landscape character: rolling grassland valleys dotted with sporadic trees growing where sheep and other herbivores, such as deer and feral goats, cannot reach. Members of the Group identified a conflict of values in this landscape character that is hard to reconcile: on the one hand, the hills are positively valued for their affective and aesthetic qualities, while on the other they are negatively valued because of their ecological composition: '…many residents in the Southern Uplands of Scotland have become increasingly uneasy at the fact that their familiar, beautiful, but mainly naked countryside is ecologically devastated' (Wildwood Group, 2000a, p. 6).

Direct experience of this 'ecological devastation' set in motion the idea of undertaking an ecological restoration project somewhere in the former royal hunting forest known historically as the Ettrick Forest, a 'loosely defined upland region roughly enclosed by a line joining Peebles, Biggar, Moffat, Hawick and Galashiels' (Wildwood Group, 2000a, p. 7):

> The woodland fragments [of the Ettrick Forest] are mainly thin ribbons beside burns in the most precipitous parts of the cleuchs…It was an encounter with such a fragment on a steep bank in a barren valley near Talla, and a distant view of the solitary clump of

> birches on a tiny islet in Loch Skeen, which engendered the idea of restoring the wildwood to a whole valley.
>
> (Wildwood Group, 2000a, p. 7)

With this in mind, the Group started to produce a landscape restoration strategy, culminating in the Wildwood Group's mission statement that guides the Group's activities to this day:

> The Wildwood project aims to re-create, in the Southern Uplands of Scotland, an extensive tract of mainly forested wilderness with most of the rich diversity of native species present in the area before human activities became dominant. The woodland will not be exploited commercially and the impact of humans will be carefully managed. Access will be open to all, and it is hoped that the Wildwood will be used throughout the next millennium as an inspiration and an educational resource.
>
> (Wildwood Group, 2000a, p. 6)

We can see here that desired woodland qualities represent a particular constellation of ecological, ethical and environmental aesthetic values. Here, *sensu stricto* ecological restoration is precision 'recreation' of a particular moment in the valley's distant history that exhibits both material presence (a diversity of native species) and material absence (the 'impact' of humans and commercial exploitation). Intrinsic ecological value is attributed to the future woodland, but it is also instrumentally valued as a psychosocial resource.

While the Group identify the loss of trees due to land use as a form of environmental degradation, the posited remedy was not simply 'reforestation' as has been practiced in southern Scotland by the Forestry Commission since post-World War II; such reforestation efforts have been characterized by the Group as plantations of 'alien conifers' that has resulted in 'great

tracts…being covered by regimented blocks of uniform green monoculture…landowners were busy 'coniferising' even the tiny pockets where native trees survived' (Ashmole and Ashmole, 2009, p. 16). Instead, the Group set the goal of restoring the site to 'original-natural' woodland, as per George Peterken's (1996) concept: 'the state that existed before people became a significant ecological factor' (Peterken, 1996, p. 13; Wildwood Group, 2000a, p. 26).

To elucidate the species present at the point in time 'before people became a significant ecological factor', the Group turned to the work of Richard Tipping, an environmental historian and archaeologist based at the University of Stirling. Tipping was commissioned in 1994 by the National Trust for Scotland to undertake peat sampling within a peat bog called Rotten Bottom that is located within the valley. Peat samples were radiocarbon dated, and pollen grains and spores of lower plants were identified and counted to create a 'series of 'snapshots' of changing plant communities' within Rotten Bottom from the end of the last Ice Age (10,300 YBP) to the present day (Ashmole and Tipping, 2009, p. 77).

Through the millennia, there has been a fluctuation in both the number and density of species present at the Carrifran site. For example, hazel and birch are recorded in the earliest records, with pine following 'soon afterwards', elm and oak at about 9,000 YBP, and alder about 6,800 YBP (Ashmole and Tipping, 2009, p. 78). Out of this fluctuation, Tipping identified 6,500-6,000 YBP, during a warm period known as the Holocene Climate Optimum, as a time that 'probably represents the fullest development and richest species assemblages of these woodlands' (Tipping, 1998, p. 12). Additionally, 6,000 YBP marks the turning point in social history when human populations transitioned from Mesolithic hunter-gatherers to Neolithic settled agriculture (Ashmole and Ashmole, 2009, p. 108); it is estimated that from about 5,800 YBP animal grazing led to a decline in woodland at Rotten Bottom (Tipping, 1998, p. 14).

Thus, it was decided that 6,000 YBP – a time that represents maximum historical woodland biodiversity – was to be the project's historical reference point. From this, 'the implication was

that we would aim to establish all – and only – the species of trees and shrubs that had been in the area at that time' (Ashmole and Ashmole, 2009, p. 108). As a note of caution, George Peterken made it be known to the Group that, due to changing ecological factors since this time, particularly climate and soil, the Group could not 'turn the clock back' (Ashmole and Ashmole, 2009, p. 109). However, the Group still 'reckoned that the altitudinal range and variety of conditions at Carrifran would allow us to find appropriate places for nearly all the kinds of trees and shrubs that had been present 6000 years ago' (Ashmole and Ashmole, 2009, p. 109). As a result, it was settled within the Group that 'native species are defined as those present in the pollen record for the site prior to the onset of human impact' (Wildwood Group, 2000a, p. 26).

Once the Group had a particular historical time set as a strict target for the restoration project, they could then supplement the pollen and spore data to further refine the information being fed into the production of the reference model. Tree, shrub, and other woody plant species considered native to the valley 6,000 YBP, and thus suitable for the restoration project, were inferred by a few small tree stands extant in areas inaccessible to grazing sheep and goats along Carrifran Burn, which traverses and drains the valley: 'the relict stands of trees were frozen in time. The first edition of the Ordnance Survey map, published in 1859, shows groups of trees in the same places – and only the same places – where we found them in summer 1996' (Ashmole and Ashmole, 2009, pp. 81-82). Further, Chris Badenoch – at the time employed by Scottish Natural Heritage – provided a list of ancient woodland species that would have been present in the region (Ashmole and Ashmole, 2009, p. 114).

In the literature, we have seen that there is much discussion about the use of temporal information in the production of reference models; it is important, however, to not neglect the importance of spatial information. At Carrifran, the information necessary to reconstruct the spatial qualities of the woodland 6,000 YBP, including where different species would have grown, in what densities, and in what spatial relations, was largely missing. Peat, pollen and

spores were sampled at Rotten Bottom, so this information had to be generalized to account for the historical vegetation of the *whole* Carrifran site.

In practice, this meant that the Group attempted to ascertain where each historically native species would most likely become successfully established within the *contemporary* valley. This was achieved through the application of two different types of classification systems: the Forestry Commission's Ecological Site Classification system (ESC) and the Joint Nature Conservation Committee's (JNCC) National Vegetation Classification system (NVC).[1] Through combining information derived from the ESC and the NVC with the (historically) native species list, the Group produced a map identifying the proposed location of woodland community types, and thus a reference model intended to serve as a design guideline for planting activities.[2]

The different techniques used to infer the historical ecological composition of Carrifran, guided by the rubric of 'original-natural' woodland, make clear the degree to which emphasis is placed on historical fidelity (*sensu stricto*) to the Carrifran site of 6,000 YBP. With this emphasis we see a claim of authenticity in the reanimation of a historical landscape state. Clearly, nativeness is a core constituent of this claim of authenticity. Only floral species deemed native to the site 6,000 YBP will be established. This practice of 're-nativisation' (Trigger *et al*., 2008, p. 1275), raises a whole set of questions regarding the meaning of indigeneity and belonging in the landscape. Even though a species may not have grown in southern Scotland for thousands of years, the Group still may label it as native, and so categorise it as permissible to plant, as is the case with yew (*Taxus baccata*).

This led to debate within the Group over the degree of authenticity that is necessary in the pursuit of original-natural woodland. Small-leaved lime (*Tilia cordata*) serves as an example. Several pollen grains of the species were found at Rotten Bottom, but George Peterken believed that the species had probably never been native as far north as Carrifran (Ashmole and Ashmole, 2009, p. 116). Even still, Peterken stated that it may be worth planting some individuals, and some

members of the Group agreed with this: when future predictions of the region's climate were taken into account (summer temperatures need to be higher than at present in Scotland for the species to set seed), it was thought that small-leaved lime could actually survive at Carrifran. However when Adrian Newton, who led the Wildwood Group's Ecological Planning Group, heard about this he stated the following:

> For me the goals were set in stone from the beginning; there was almost a romantic notion of restoring an original wildwood (or as near to it as we could get). Personally I wouldn't want to see that compromised….Very few other restoration projects either share that goal or have pursued it so rigorously. There are many other restorations that have had a much laxer view of what they should establish; this is what sets Carrifran apart.
>
> (Newton quoted in Ashmole and Ashmole, 2009, p. 116)

Here, the claim of restoring an 'original' wildwood is defended on the grounds that to do otherwise would be a 'compromise'. Such a 'lax view' of what should be planted would make the project more akin to a form of trial and error 'gardening', which would undermine the 'ecological credentials' of the restoration (Newton quoted in Ashmole and Ashmole, 2009, p. 116), and thus weaken a purist 'romantic notion'. As a result, the species was taken off the planting list (Ashmole and Ashmole, 2009, p. 116).

This claim of authenticity is not a head-on rebuttal of the anti-restoration proposition that has been pursued by environmental philosophers such as Robert Elliot and Eric Katz: that ecological restoration produces an artifactual, 'fake' nature, where intrinsic value has been lost (see especially Elliot, 2000, 1997; Katz, 2000). There is an assumption within the Group that it is feasible to carry out a restoration without losing ontological value, even if human intentionality is the driving force. In the absence of this assumption, the goal of 're-creating' forested

wilderness, as per the mission statement, would be untenable. Rather, this claim assumes that with the correct knowledge, a historically accurate reference model can be produced, out of which a historically authentic restoration may emerge. This assumption underpins much ecological restoration practice and theory, not only for those projects that have a variant of 'wilderness' as a goal. Egan and Howell's (2001) introduction to their edited volume on reference ecosystems makes this clear: 'restorationists must search out the missing, forgotten, and overlooked aspects of the ecosystem they wish to restore and, once they find them, begin to reassemble them into a viable system….the answers are there – concealed, as David Abram (1996) puts it, in "the very depths of this living place"' (Egan and Howell, 2001, p. 1).[3]

This claim of reference model authenticity is augmented by a chance discovery made in 1990 by the late Dr Dan Jones. While he was out hillwalking through the valley, he found two-thirds of the remains of a yew longbow buried in the peat at Rotten Bottom. The Crown subsequently claimed the bow under the Scottish Treasure Trove law; prior to it being put on public display at the National Museum of Scotland in Edinburgh, it was sent to Oxford University for carbon dating where it was dated at approximately 6,000 YBP (Martynoga, 2009, p. 101). The discovery of the longbow, while interesting from an archaeological perspective (Sheridan, quoted in Martynoga, 2009, p. 101), directly intersects with the targeted reference model. Not only do they both share a historical point in time, they are easily intertwined with one another through narrative as they mutually support a similar conception of human engagement with the landscape. The reference model envisions a wild, humanly depopulated woodland, and the bow as an artefact, thought to have been discarded by a hunter-gatherer during a hunt or in death (Martynoga, 2009, p. 101), is deployed to narrate human engagement that is temporal, mobile, and small-scale, while foregrounding the maximal floral diversity of 6,000 YBP. Indeed, the story of the bow was seized on by the Group for its 'charismatic' qualities (Carrifran Wildwood

Interview #1); it thus produces an engaging narrative containing affective (Strohmaier, 2003) and imaginative aesthetic value (Brady, 1998). For instance, the following text is taken from the Group's fundraising brochure produced in 1998, which 'became the mainstay of our fundraising for the next two years' (Ashmole and Ashmole, 2009, p. 47):

> 6,000 years ago, in the peat bogs of Rotten Bottom a yew hunting bow broke and was discarded….Nothing is known of its owner. However, it is certain that the panoramic view from that site was very different from the one seen today. The now naked valley was clothed in rich diversity of tree and shrubs, and home to a wide variety of wildlife. This is the view of the past…it is also our vision for the future.
>
> (Carrifran Wildwood fundraising brochure, 1998)

Another example can be found on one of the three *in situ* signs now present in the valley, under the heading 'A broken bow – a changing landscape':

> The first people to explore the valley would have lived in small nomadic groups, hunting for their food and moving from place to place with the seasons. These hunter-gatherers probably had little impact on the landscape – but later farmers certainly did.

The fragment of a broken longbow thus helps to narrate desired human behaviour within the woodland – movement *through* the landscape rather than settlement *within* – which is ultimately non-threatening to the construction of a wilderness woodland character. The narrative also succinctly links directly to the idealised historical landscape state, and gives weight to the Group's claim of authenticity. It speaks to what Holland and O'Neill (1998) term 'diachronic integrity'; that is, the selection of the most appropriate trajectory of a landscape's narrative based

on that landscape's history, in a way that transfers the maximum possible 'significance' or value into the future. The reference model selected is thus legitimised by the discovery of the bow, and in turn reinforces that the values which serve as its basis are appropriate to this part of the Scottish landscape.

ii. Ecological Restoration in Walden Woods

When Henry David Thoreau (1817-1862) moved to the shores of Walden Pond (Concord, Massachusetts) in July 1845 for what became a two-year sojourn, he did so because he 'wished to live deliberately, to front only the essential facts of life. And see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived' (Thoreau, 2004 [1854], p. 90). Self-characterised as 'a mystic, a transcendentalist, and a natural philosopher to boot' (Thoreau, 1853 in Thoreau, 1906b, p. 4), Thoreau has long been regarded and respected as a (if not the) founding father of American environmentalism. His accounts of daily life in Walden Woods, coupled with broader discussions of nature, self-reliance, individual freedom, society, and government – brought together in *Walden* (Thoreau, 1854) – firmly established him as a stalwart of an emerging environmental movement, but also as a voice, a commentator, on political reform and social activism.

When Walden Woods[4] came under threat from commercial and residential development in the late 1980s – manifested through the proposed construction of an office building and condominium complex on two sites of historical, ecological, but also, importantly here, *literary* significance – the Walden Woods Project (established in 1990) emerged as a response to the immediate threat. Having recently celebrated its quarter-centenary in April 2015, the Walden Woods Project (hereafter WWP) remains committed to 'preserving the land, literature and legacy of Henry David Thoreau through conservation, education, research and advocacy' (WWP, 2015). It has achieved much in its 25 years, for alongside its land acquisitions and purchases sit a

number of successful collaborative ecological restoration projects. It is important to note here that the WWP is not the first group to seek to restore Walden – indeed, a legacy of ecological restoration projects can be traced back to the 1950s, and it is in fact one of these earliest projects that comprises our *sensu stricto* ecological restoration example – but the WWP appears here as the vanguard and pioneer of a more formalized and sustained 'Walden restoration.' Spanning more than half a century, restoration projects at Walden have included both *sensu stricto* restorations (e.g. shoreline restoration at Walden Pond), and *sensu lato* restorations (e.g. the restoration of the former Town of Concord landfill; creation of Thoreau's Path on Brister's Hill).

Underpinning both the *sensu stricto* and *sensu lato* restorations at Walden is a desire to restore 'the Walden of Emerson and Thoreau'. One of the earliest adoptions of this phrase appears in the 1922 Deed of Gift from the Emerson, Forbes, and Heywood families, and signalled the beginning of land conservation in Walden Woods. This Deed of Gift saw almost 80 acres deeded to the Commonwealth of Massachusetts (and later, Middlesex County), and in turn provided the foundation for the establishment of the 462-acre Walden Pond State Reservation. The deeds requested that:

> The sole and exclusive purpose of this conveyance to aid the Commonwealth in preserving the Walden of Emerson and Thoreau, its shores and nearby woodlands, for the public who wish to enjoy the pond, the woods [and] nature.
>
> (Wheeler, 2004, p. 197)

The idea of restoring 'the Walden of Emerson and Thoreau' is particularly interesting for our discussion of *sensu stricto* restoration goals, for at first glance, it explicitly speaks back to an incredibly narrow reading of 'ecological restoration'. Walden Pond existed long before Thoreau took up residence on its shores, yet it is a *literary imaginary* firmly rooted in the 1840s

and 1850s that appears to be driving ecological restoration, over any preceding or succeeding inhabitants and/or time periods. However, as Couture (1993) qualifies:

> It is the consensus of both Thoreau and Emerson scholars, as well as of those whose concern is primarily ecological rather than literary, that the Walden of Emerson and Thoreau would be a dynamic, self-sustaining ecosystem characterized by balanced populations of indigenous species occupying natural, unaltered landscape features, not the Walden that happened to exist at one particular moment in time.
>
> (Couture, 1993, p. 275)

Meanwhile, for Jordan (1993, p. 262), the Deed of Gift demands 'restoration to the 19th-century condition, and restoration means just that – not making a place nice, or making it match our notions of its earlier condition, but bringing it back as best we can back into the condition it was actually in that period.'

Walden Woods as it exists in 21st century America is still markedly different from Thoreau's Walden of the 1840s. This is not a simplistic and superficial nod to the fluidity and mutability of ecological processes, but rather that a reading of a restored 'Walden of Emerson and Thoreau' contains a further caveat. As illustration of this, Walden Woods is no longer the working landscape that Thoreau would have recognised, subjected to 'wood-chopping, ice-cutting, or the like business' (Thoreau, 2004 [1854], p. 213), but is instead one that now adheres to and echoes 21st century conservation and restoration sensibilities. This necessary compromise and consolidation contributes a further dimension to our discussion of ecological restoration reference models.

As compared to the modelling procedure at Carrifran Wildwood, a different approach emerges at Walden. Henry David Thoreau wrote extensively on the nature and natural history of Walden,

Concord, and beyond, and was 'a keen observer of changes in the seasons and differences in the landscape from one year to the next. *Walden* contains chapters devoted to individual seasons, and he intended to expand his later observations into a book entirely about the seasons' (Primack, 2014, p. 29; also Thoreau, 2016; Angelo, 2016; Thorson, 2014; Robinson, 2013; Case, 2013 and Thoreau's 'Kalendar;' Brain, 1993). As Schofield (1993, p. 168) comments of *Walden*, 'it is remarkable that a literary work should contain such an ecologically meaningful catalogue of species for one site. The fact the *Walden* does contain such a catalogue demonstrates the intimate link between *Walden* the book and Walden Woods. *Walden*'s ecological veracity answers, perhaps, to the book's artistic and spiritual veracity.' Moreover, it was at Brister's Hill in Walden Woods that Thoreau formed his theory of the ecological succession of plant species through seed dispersal - recounted in 'The Succession of Forest Trees' (Thoreau, 1860) and 'The Dispersion of Seeds' (in Thoreau, 1993). It is through Thoreau's observations at Walden – drawn not only from *Walden*, but also from across journals, and essays – that the historical reference point was set for the *sensu stricto* shoreline restoration at Walden Pond.

Thoreau also reveals early restoration sensibilities through the restoration of his bean-field site over a decade after his sojourn at Walden Pond (cf. Dean, 2005). In his journal entries for April 19-21, 1859, he records,

> *April* 19. […] P. M. – Began to set white pines in R. W. E.'s Wyman lot.
>
> *April* 20. […] Setting pines all day.
>
> *April* 21. Setting pines all day. This makes two and a half days, with two men and a horse and cart to help me. We have set some four hundred trees at fifteen feet apart diamondwise, covering some two acres.

(Thoreau, 1859, in Thoreau, 1906c, p. 152)

For Jordan (1993, p. 264), a restoration sensibility runs through Thoreau's philosophy in three distinct ways: 'Thoreau's experiment in the reentry and reinhabitation of nature; the theme of renewal, which is at the core of *Walden*; and the discovery that the key to renewal is the imagination expressed through a performative relationship with the world – actually a kind of deadly serious, highly playful make-believe.' So by extension, 'Walden restoration' for Jordan (1993, p. 265) continues Thoreau's experiment; it is 'a way of carrying out Thoreau's agenda, as it were, and in fact popularizing it, while avoiding the undesirable consequences this might have for the environment. […] restoration entails essentially all the interactions with nature Thoreau pursued at Walden.'

There have been two distinct phases of shoreline restoration at Walden Pond: the first, spearheaded by the Save Walden Committee of the Thoreau Society, saw the restoration of Red Cross Beach in the late-1950s and early-1960s, while the second, completed during the 1980s and 1990s by the Walden Pond State Reservation, centered on shoreline stabilization.[5] When Middlesex County set out to create a new beach area at Red Cross Beach so as to accommodate more swimmers, part of the bank was cut away and moved into the Pond, and trees were felled. The Save Walden Committee filed a lawsuit against Middlesex County for impinging the conditions of the 1922 Deed of Gift (Maynard, 2005; Wheeler, 2004, and as a consequence, the Commissioners were required to:

> Restore 'the Walden of Emerson and Thoreau', to the extent that restoration is practicable […] 'to restore much of the sylvan charm of the denuded area' by proper replanting of trees and shrubbery, and that such replanting and reforestation could be accomplished

> more effectively by removing the roadway and building new contours with additional fill […]; that it would be practical to restore the demolished section of the ancient foot-path encircling the pond […]; and that the proposed new bathhouse would 'mar the beauty of the shore'. […] steps should be taken to prevent erosion in the area and to restore the footpath.
>
> (Commonwealth of Massachusetts, 1958, p. 12)

And yet, as noted by the County Commissioners of Middlesex County (1958) at the time, 'After 115 years, who knows what was 'the Walden of Emerson and Thoreau,'' again echoing the normative judgements of restorers.

By the 1980s, a comprehensive shoreline stabilization and restoration program was introduced, which also set out to repair trails around the Pond – as a panel at the entrance to Walden Pond states, 'Walden Pond is undergoing a major trail improvement and bank restoration project' (WPSR onsite interpretation, 2007). Along the shoreline, plantings were based on the botanical observations and recordings made by Thoreau (see especially Schofield and Bush-Brown, n.d.; also Walker, 1993), and the style of paths and trails echoed the Indian paths noted by Thoreau (WPSR Interview #1; cf. Thoreau, 1851, in Thoreau 1906a, p. 455-457).

The importance of spatial information to the production of reference models that we saw in the Carrifran Wildwood case, is further exemplified in Primack's (2014) study into the effects of climate change on the flora and fauna of Concord. Primack uses Thoreau's detailed observations from the mid-19th century of 'the dates of flowering and leaf-out times, when birds arrived in the spring, the date of ice-out at Walden Pond, and other natural phenomena in Concord' (Primack, 2014, p. 5; cf. Thoreau, 2016; Case, 2013; Walker, 1993) and his own team's observations from across the opening two decades of the 21st century to trace the ecological implications of a warming climate.

As with the Carrifran Wildwood reference model, the reference model at Walden reveals a dual reading of, and claims to, 'authenticity,' for it again speaks not only to an authenticity of *value*, but also to an authenticity of *encounter*. This authentic value in the Walden reference model is found primarily in its deep-rooted ties to Thoreau's ecological legacy. A Walden restoration reference model invokes the literary imaginary of Henry David Thoreau, so much so that when Walden Woods came under threat from development in the late-1980s, the Concord Historical Commission (1988, cited in TCCA 1988, p. 5) remarked that, 'To build an office park on Brister's Hill is to assault the historic integrity of Walden Woods. […] On Thoreau's own ground his wishes should not be contradicted by some notion of progress. Thoreau's opinion, not Boston Properties', should prevail.' To borrow Couture's (1993, p. 276, emphasis added) phrasing, this represents one way of 'pursuing the cause of *ecological sanctity* at Walden.'

If we accept the reference model of 'Walden restoration' as valuing 'the Walden of Emerson and Thoreau,' we must also acknowledge the paradox herein concerning what we term the naturalization of transport infrastructure within Walden restoration narratives. Thoreau's arrival at Walden Pond in 1845 was preceded the year before by the completion of the Fitchburg Railroad through Walden Woods. Because of the presence of the railroad in *Walden* (Thoreau, 1854) especially, but also in Thoreau's journals, it quickly assimilated into the literary landscape of Walden Woods. As illustration of this:

> The Fitchburg Railroad touches the pond about a hundred rods south of where I dwell. I usually go to the village along its causeway, and am, as it were, related to society by this link. […] The whistle of the locomotive penetrates my woods summer and winter, sounding like a scream of a hawk sailing over some farmer's yard, informing me that many restless city merchants are arriving within the circle of the town, or adventurous country traders from the other side.

(Thoreau, 2004 [1854], p. 115)

Indeed, as Thoreau reveals in the above observation, so embedded is the railroad in the landscape that he would often walk along the railroad causeway to Concord.

It is, however, Thoreau's acknowledgement of the intrusion of the railroad in Walden Woods – 'That devilish Iron Horse, whose ear-rending neigh is heard throughout the town, has muddied the Boiling Spring with his foot, and he it is that has browsed off all the woods on Walden shore' (Thoreau, 2004 [1854], p. 192) – that interests us most here, granted more contemporary transport developments through Walden Woods. Route 2 and Route 126 now also transect Walden Woods, and materialistically, the ecological disturbance caused by the railroad does not significantly differ from these modern intrusions. It is, simply, the railroad's Thoreauvian association which sets it apart. And all this, despite the fact the 'locomotives would soon devour much of the woods' timber, and flying sparks would routinely ignite fires along the right-of-way' (Maynard, 2005, p. 54).

The question of ecological authenticity in the Walden reference model is further shaped by claims of authentic encounter, grounded in and explored through Thoreau's observations on ideas of 'wildness' and 'wilderness.' In much of Thoreau's writings, Walden is represented as a wild landscape – 'The wildest scenes had become unaccountably familiar' (Thoreau, 2004 [1854], p. 210) – but as Donahue (1993, p. 181-182, also 2007; cf. Jordan, 1993, p. 267-268) notes, 'there was arguably less wildness in Concord in Thoreau's time than there is today. By 1845, Walden Woods was hardly the edge of the great American forest. It was one of the few patches of woods remaining in Concord. […] Thoreau's Concord was a deforested, farmed out, environmentally degraded landscape. […] This was the environment to which Thoreau reacted.'[6] And following a visit to Mount Katahdin in Maine in 1846, Thoreau offers the following addendum:

> Those Maine woods differ essentially from ours. There you are never reminded that the wilderness which you are threading is, after all, some villager's familiar woodlot, some widow's thirds, from which her ancestors have sledded their fuel for generations, minutely described in some old deed which is recorded, of which the owner has got a plan too, and old bound-marks may be found every forty rods, if you will search.
>
> (Thoreau, 2004 [1864], p. 152)

For Thoreau, the experience at Katahdin forced him to question what constitutes authentic encounters with wild nature (cf. Elliot's (1997) wilderness experience scenarios and the desire for an ethically 'correct' type of ecology to be brought about by ecological restoration), and specifically the *ecological* and *geographical context* in which these encounters occurred.

The Normative Visions of Reference Models

In the extant literature on ecological restoration, we see the consistent assertion (whether implicit or explicit) that reference models are scientific-technical guides for directing restoration activities, based upon biological and/or cultural data, and that they tend to be thought of as fairly discrete and stable objects, such as maps and written descriptions. Through describing the making of two reference models, we think that such a reading of how reference models come into being is insufficient. While both projects do indeed draw from such a range of data sources, including pollen analyses and written botanical records, for the purpose of producing guidelines for restoration activities, this only comes *after* deciding exactly what a restoration project should actually restore, which involves making normative judgements about what constitutes degradation and recovery. So, in the case of Carrifran Wildwood, normative judgements about the ecological composition of the Southern Uplands led to the formulation of restoration

objectives for a wild woodland ecosystem, and subsequently the search for a historical landscape state to act as a strict reference model. At Walden Pond, the historical reference model speaks back to the legacy of Thoreau's ecological philosophy and writings, and it is this legacy which in turn molded 'Walden restoration' practices. In both cases then, a reference model was produced that *best reflected* the normative judgements of restorers. Thus, the two reference models critiqued here are not merely based upon the amalgamation of cultural and ecological data (though they are partially that), but also inter-subjective expressions of a range of different types of value – inter-subjective in the sense that there is broad inter-group agreement within a restoration project about the appropriateness of these values.

Our description of the making of two reference models leads us to contest not only how they are assumed to come into being, but also the role that reference models play within an ecological restoration project. While the reference models do guide restoration activities – particularly at Carrifran Wildwood where plant species are precisely mapped out across the valley – we see them as having a wider function than this, which is to communicate both internally and externally each groups' discrete set of inter-subjective values – of ecological authenticity, sanctity, literacy and legitimacy; of ethics and aesthetics; of wildness and wilderness – values that may otherwise be challenging to represent. We therefore consider reference models as not only scientific-technical guidelines for restoration practice, but also as normative visions of desired future ecosystem states.

Internally, both reference models act as a means of giving substance to these values, and so provide a concrete and inspiring vision to those involved in the restoration project. At Carrifran Wildwood this is an inter-generational vision, given the centurial time frame in which the project is operating (*reference removed for blind review*). Externally, the reference model is narrated to interested or regulatory organizations and members of the general public, through various means. At Carrifran Wildwood, we have seen how the story of the charismatic bow was told through

fundraising brochures and signage within the valley; this story explains and legitimises the appropriateness of the reference model – including the envisioned social relations with the valley – in a coherent manner, to those outside of the project.

Additionally, the Group needed to outline to various governmental organizations the likely impacts of implementing the reference model. For example, the production of an Environmental Statement (ES) was a necessary requirement set by the Scottish Forestry Commission. As a part of this a visual landscape assessment was required, which needed to explain and qualify any visual impacts the tree planting activities proposed in the reference model would likely have on the existing scenic attributes of the landscape. Photographs and line drawings detail, for instance, how planting at the valley's extremities will 'soften' its boundary with adjacent land, including the planting of evergreens to 'visually interlock' with a pre-existing Forestry Commission conifer plantation (Wildwood Group, 2000b, p. 45). Therefore, there may be some negotiation between internal group values and external organizational values – in this case aesthetic values – in formulating how the reference model will be executed.

At Walden, promotion of the reference model used in the shoreline restoration, slope stabilization, and replanting around Walden Pond is more subdued. At Walden Pond State Reservation, the reference model informs the 'restoration schedule 1996-1997/1997-1998' detailed on signage at the entrance to the Pond, but this is its sole presence. And in outputs from the Thoreau Society, whose Save Walden Committee spearheaded the 1950s restoration campaign, it is reference to 'the Walden of Emerson and Thoreau' that dominates, not a 'reference model' per se—as seen in publications *The Concord Saunterer: A Journal of Thoreau Studies* (e.g. Wheeler, 2004) and within the quarterly compendium, the *Thoreau Society Bulletin*.

The reference models of Carrifran Wildwood and Walden Woods support Clewell and Aronson's statement that an agreed-upon 'reference can greatly aid in the process of galvanizing support and consensus among participants and stakeholders at the outset and during

implementation of a restoration project' (2007, p. 86). We want, however, to push this further, as we see the reference model not only as a 'galvanizing' tool, but also as an *argument* in favour of particular social and ecological values including desired future human-nature relations. In short, the Carrifran and Walden reference models simultaneously reflect and advocate certain values. From this position, we now want to move on to demonstrate how it is difficult to conclude that reference models are chosen 'arbitrarily', which has been claimed within much of the ecological restoration literature.

The Non-Arbitrary Nature of Reference Models

We have already seen that the notion that restorationists can recuperate a historical landscape state has been criticized as being an unrealistic goal, given the various unpredictable ecosystem changes that occur through time. Another critical line of thinking with regard to reference models that has been developed within the ecological restoration literature is that, given many previous historical landscape states may be legitimate targets for restoration efforts – coupled with the stochastic nature of ecosystems – the state that is eventually chosen as a reference is necessarily *arbitrary*. As Alagona *et al*. (2012) state: 'Restoration requires historical baseline targets, but all such targets are arbitrary for ecosystems that are constantly changing and have always been doing so' (Alagona *et al*., 2012, p. 65). Such a position has been constantly affirmed across the natural and social sciences, including by those broadly supportive of historically-aligned restoration efforts (Allen *et al*., 2002, p. 1422; Choi, 2007; Helford, 1999, pp. 60-61; Higgs, 2003, p. 119; Moreira *et al*., 2006, p. 220; Pickett and Parker, 1994; Seddon, 2010; Van Der Heijden, 2005; White and Walker, 1997, p. 342). Amongst these accounts, this position is presented as self-evidently true, to the point that it is assumed to be a well-recognised problem inherent to restoration:

> There are at least three problems with the field of restoration ecology. First is the arbitrariness of determining which time period in the past should be the target of restoration efforts. In the United States, this has typically been assumed to be before settlement by Europeans. But why should that be the target any more than the time before the native Americans settled the region?
>
> (Davis, 2000, p. 1203)

It is our contention, however, that in the case of the Carrifran Wildwood and Walden Woods restoration projects, the historical landscape state upon which both reference models are based has been *purposefully* selected, which leads us to question the abiding assumption that reference models are necessarily chosen in an arbitrary manner. As we have demonstrated, a discrete set of values motivated the initiation of both restoration projects; only after these had been set was a project's historical reference point selected that best aligned with these values. In the case of Carrifran Wildwood, the values underpinning the restoration of a wildwood ecosystem at the temporal point before 'people became a significant ecological factor' meant that 6,000 YBP was considered to be the most appropriate historical reference point. In the absence of specific normative judgements about what was desirable for the site's future, the selection of 6,000 YBP as a reference point may well have been arbitrary - if maximal woodland floristic diversity is not judged to be of any significant value, why not restore to 4,000 YBP? - but the impetus to initiate ecological restoration would be missing. In the case of Walden Woods, the values underpinning the shoreline restoration, slope stabilization, and replantings at Walden Pond emerge out of the observations and recordings of Henry David Thoreau. The extent of Thoreau's writing - his journals alone total more than one million words - provides a rigorous, detailed natural history compendium of the Concord locale across the 1840s and 1850s for restorationists to reference.

But moreover, as we have discussed, this two-decade period also represents the wider, burgeoning development of American environmental sensibilities - pioneered by Thoreau - with Walden at the epicentre.

Conclusions

Through retracing the genesis of two ecological restoration reference models – one in Scotland, and one in the United States – we propose a new understanding of what it is that reference models represent and what roles they play in a restoration project. We firstly demonstrated that the way in which reference models are produced precludes reading them as simply scientific-technical guidelines for restoration activities; instead, we showed that they are also inter-subjective expressions of different types of ecological and social values. In turn, we outlined the communicative function of these reference models, wherein they act as intermediaries between these values and their realisation. We therefore consider ecological restoration reference models to be normative visions of desired future ecosystem states, which encompass particular types of social relations. Lastly, due to the normativity of reference models, we challenged the widespread assumption that the historical landscape state that informs such models are chosen arbitrarily; on the contrary, we set out how such states are purposefully chosen so as to best reflect the values that each group is seeking to (re)inscribe through ecological restoration practice.

We need to caution against making generalizable claims about the role of normativity within and across *all* ecological restoration reference models. Nonetheless, if the role of values in the selection of a reference point were brought to the fore in other restoration projects, we may well find that they are likewise normatively driven and non-arbitrarily chosen. Given that the two case studies included in this discussion differ dramatically in both intent and purpose, this article argues for the importance of considering *the role of values within the production and application of reference models*. Our discussion begins to consolidate the place—and power—of normativity

in the design and application of reference models, but further, sustained investigations on the role of normativity within other types of restoration models would allow us to build a more complete picture of the rationales and justifications underpinning restoration reference model practices.

Notes

1. We do not have space to detail these two classification systems, so see Forestry Commission (2001) for information on the ESC, Rodwell (2006) on the NVC, and Ashmole and Ashmole (2009, pp. 117-122) for details of their application at Carrifran.

2. A map detailing planting in the valley, based upon the classification schemes, is available here: http://www.carrifran.org.uk/wp-content/uploads/2012/01/carrifran-_map_for_website_09_dec_11.pdf

3. Other literature similarly makes this point, for example the Society for Ecological Restoration's primer on ecological restoration, which states that 'the value of the reference increases with the amount of information it contains' (SER, 2004, p. 8).

4. The Walden Ecosystem is defined as a '2,680-acre (1,000-hectare or ca. 4-square-mile) tract of woodland, wetland, and other habitats lying east of the Sudbury River in the contiguous towns of Lincoln and Concord, Middlesex County, Massachusetts…About 1,500 acres lie in Lincoln, 1,180 acres in Concord' (Schofield, 1989).

5. For further discussion of the *sensu stricto* restoration of Walden Pond, see especially Smith (2014), Maynard (2005), Wheeler (2004), Couture (1993), and Jordan (1993).

6. Indeed, in 1844, Thoreau and a companion accidentally set fire to a 300-acre swath of Walden Woods (cf. Pipkin, 2009), and during his stay at Walden Pond, Thoreau also cut down part of the Woods to plant his bean-field (Thoreau, 2004 [1854], pp. 155-166).

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